REMARKS

Pending Claims

Claims 1-25 are pending. The Applicant respectfully requests reconsideration of claims 1-25 in light of the arguments presented herein.

Rejections under 35 U.S.C. §103 as Being Obvious

Claims 1-25 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 6,445,837 to Hanza (hereinafter "Hanza"). To be unpatentable under 35 U.S.C. §103(a), the differences between the subject matter sought to be patented and the prior art must be such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art. There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify or combine the reference teachings. To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.

Independent Claim 1 and Dependent Claims 2-15

The Office Action states that Hanza fails to specifically disclose the optical sources, and the inputs and lenses being positionable so that they are aligned. The Office Action further states that Hanza does, however, disclose a phase mask pattern, which is placed on the surface of the circuit in order to determine the position of the waveguide and optical elements. The Office Action concludes that it would be obvious at the time the invention was made to a person having ordinary skill in the art that the lenses are positionable so that they are aligned because Hanza discloses a phase pattern mask placed on the circuit in order to align all the optical elements.

The Applicant's Attorney respectfully disagrees with the Examiner's characterization of the teachings described in Hanza. The Applicant's Attorney believes that the phase pattern mask described in Hanza is used to write the Bragg grating waveguides 6 (FIG. 3B) in the hybrid circuit 103 that is described in connection with FIG. 3. See Hanza Column 6, lines 62-67 that states in part "[t]o write a good quality grating, a phase mask is required." The Bragg grating

waveguides are part of the external cavity laser that is described in connection with FIG. 3B. See Hanza Column 6, lines 25-31.

The Applicant's Attorney submits that the phase grating described in Hanza is not used to align all of the optical elements as suggested by the Examiner. Instead, it is submitted that Hanza teaches adaptive lithography techniques to create a desired pattern of waveguides and other deflecting optical elements to correspond with positions of the optical and electronic devices relative to the substrate. Precise alignment of optical waveguides to optical device is achieved by detecting the exact position of mounted devices with an imaging system and then controlling a direct writing tool, such as a laser beam or an electronic beam, over the substrate based upon the known exact positions. Hanza describes an image processor that recognizes the actual positions of devices on a substrate and transfers the pattern of the actual device positions to a computer-controlled electron beam lithography machine where a mask is created that will perfectly align the waveguides to the optical devices. See Hanza Column 3 lines 2-7.

Hanza FIGS. 3C-3E illustrate and Hanza column 6, lines 31-61 describe the steps in which a circuit is manufactured according to the method described in Hanza. First, the two canals 16 are carved in the substrate 11 and then the optical devices 4 and 5 are mounted in the canals 16. Note that the mounting of the optical devices 4 and 5 in this step fixes the position of the optical devices. Next, the hybrid circuit 103 is mapped by high resolution viewing and imaging processes to find the exact positions of the optical device. The mapping information is stored in a computer system so that another scanning machine, such as an electron beam lithography machine, can identify the objects on the substrate. The next step is to use the location map of the optical elements on the substrate and to employ electron beam lithography for creating a pattern mask that corresponds to the waveguides and/or lenses and prisms (as shown in FIG. 3f). This method is further described in connection with the flow chart in Hanza FIG. 4.

As stated in Hanza, the position of the electron beam in an electron beam lithography machine can be controlled with sub-micrometer precision. Therefore, a precise alignment of the waveguides with the optical elements is possible with the method described in Hanza. Therefore, the Applicant's Attorney respectfully submits that it is clear from the description in

Hanza that the phase mask is not used to align all the optical elements as suggested by the Examiner.

The Applicant respectfully submits that all the claim limitations of independent claim 1 are not taught or suggested by the Hanza. Specifically, independent claim 1 recites a multi-source optical module where at least one of the first and the second lenses are positionable so that the output of a respective one of the first and second optical sources and a respective one of the first and the second optical inputs of the optical circuit are aligned. Hanza does not teach or suggest a multi-source optical module with positionable devices as recited in independent claim 1. Instead, Hanza describes mounting devices at fixed positions in the hybrid circuit and using adaptive lithography to create a desired pattern of waveguides and other deflecting optical elements that corresponds with positions of the optical and electronic devices relative to the substrate.

The methods and apparatus described in Hanza are both very complex and very expensive solutions to the problem of aligning a source to an optical waveguide in a hybrid circuit. Adaptive direct write lithography systems, such as the electron beam lithography system described in Hanza can precisely align waveguides to optical elements. However, these lithography systems can cost several million dollars and are very expensive to maintain because they include complex beam generation and motion control systems in a high vacuum environment and because they occupy significant spaces in expensive clean room real estate.

The Applicant has discovered that the precision required to fabricate optical modules with multiple optical sources can be achieved using the methods and apparatus described in the present invention. The multi-axis micromanipulator stage 300 shown in FIG. 6 of the present application, which can be used to assemble a multi-source optical module according to the present invention, costs a very small fraction of the cost of the adaptive direct write lithography systems taught in Hanza. One aspect of the present invention is that the precision required to fabricate optical modules with multiple optical sources can be achieved using relatively inexpensive equipment having a small footprint in a non-clean room environment. Such an invention renders the methods described in Hanza obsolete for fabricating the optical modules described in the present specification.

Thus, the Applicant respectfully submits that a *prima facie* argument that the multi-source optical module recited in independent claim 1 is obvious has not been made because Hanza does not teach or suggest all claim limitations. Specifically, Hanza does not teach or suggest at least the lenses that are positionable so that the output of a respective one of the first and second optical sources and a respective one of the first and the second optical inputs of the optical circuit are aligned. Instead, Hanza describes mounting devices at fixed positions in the hybrid circuit and then using adaptive lithography to create a desired pattern of waveguides and other deflecting optical elements that corresponds with positions of the optical and electronic devices relative to the substrate. The adaptive lithography approach described in Hanza is a different solution to aligning multiple optical sources in a hybrid circuit that requires very complex and expensive equipment.

Therefore, the Applicant submits that independent claim 1 is allowable over the prior art of record. In addition, the Applicant submits that dependent claims 2-15 are allowable as depending from an allowable base claim.

Independent Claims 16 and 25 and Dependent Claims 17-24

The Office Action states that Hanza fails to specifically disclose manipulating at least one of the lenses to obtain a desired coupling. The Office Action further states that Hanza discloses a phase mask pattern, which is placed on the surface of the circuit in order to determine the position of the waveguide and optical elements. The Office Action concludes that it would have been obvious at the time the invention was made to a person having ordinary skill in the art that the lenses are manipulated so that they are aligned because Hanza discloses a phase pattern mask placed on the circuit in order to align all of the optical elements.

As stated herein the Applicant's Attorney respectfully disagrees with the Examiner's characterization of the teachings described in Hanza. The Applicant's Attorney believes that the phase pattern mask described in Hanza is used to write the Bragg grating waveguides 6 (FIG. 3B) in the hybrid circuit 103 that is described in connection with FIG. 3. See Hanza Column 6, lines 25-31 and 62-66

The Applicant respectfully submits that a *prima facie* argument that the method of manufacturing a multi-source optical module recited in independent claim 16 is obvious has not been made because Hanza does not teach or suggest all claim limitations. Regarding independent claim 16, Hanza does not teach or suggest at least the steps of positioning a first lens between an output of the first optical source and a first optical input of the optical circuit and positioning a second lens between an output of the second optical source and a second optical input of the optical circuit; and manipulating at least one of the first and the second lenses to obtain a desired coupling between a respective output of the first and second optical source and a respective one of the first and second optical inputs of the optical circuit.

Regarding independent claim 25, Hanza does not teach or suggest a means for positioning a first lens between an output of the first optical source and a first optical input of the optical circuit and for positioning a second lens between an output of the second optical source and a second optical input of the optical circuit; and a means for manipulating at least one of the first and the second lenses to obtain a desired coupling between a respective output of the first and second optical source and a respective one of the first and second optical inputs of the optical circuit.

Instead, Hanza describes mounting devices at fixed positions in the hybrid circuit and then using adaptive lithography to create a desired pattern of waveguides and other deflecting optical elements that corresponds with positions of the optical and electronic devices relative to the substrate. The adaptive lithography approach described in Hanza is a different solution to the problem of aligning multiple optical sources in a hybrid circuit that requires very complex and expensive.

Therefore, the Applicant submits that independent claims 16 and 25 are allowable over the prior art of record. In addition, the Applicant submits that dependent claims 17-24 are allowable as depending from an allowable base claim.

CONCLUSION

Claims 1-25 are pending in the present application. The Applicant respectfully requests reconsideration of the pending claims in light of the arguments presented in this Response.

If, in the Examiner's opinion, a telephonic interview would expedite prosecution of the present application, the undersigned attorney would welcome the opportunity to discuss any outstanding issues, and to work with the Examiner toward placing the application in condition for allowance.

Respectfully submitted,

Date: December 23, 2005
Reg. No. 40,137

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